REMARKS

Reconsideration and further examination of this application is hereby requested. Claims 1-66 are currently pending in the application. Claims 33-66 are newly added by this amendment.

Attached hereto is a marked-up version of the changes made to the specification and claims by the current amendment. The attached pages are captioned "VERSION WITH MARKINGS TO SHOW CHANGES MADE".

A. Allowed Claims 30-32

Applicant appreciates the allowance of claims 30-32. Applicant notes that claim 30 as allowed a typographical error in that "camera" was misspelled as "cameral." The amendment of claim 30 serves to correct this error.

B. Drawing Objections

To address the Official Draftsman's objections to the drawings, formal drawings are submitted herewith.

C. The Obviousness Rejections

Claims 1, 4, and 12-29 have been rejected under 35 U.S.C. § 103(a) as being obvious over Suzuki (U.S.P. 6,307,210) in view of Nayar (U.S.P. 4,893,183). Claims 2, 3, and 5-11 have been rejected under 35 U.S.C. § 103(a) as being obvious over Suzuki in view of Nayar, and further in view of King (U.S.P. 6,236,747). These rejections are respectfully traversed based on the

following arguments.

The Suzuki disclosure utilizes optical elements to help produce an image at a single camera. Likewise, the Nayar disclosure utilizes optical elements to help produce an image at a single camera. However, any similarities beyond that are rather attenuated. The Examiner reasons that it would have been obvious for the location determination teachings of Nayar to be used by a person having ordinary skill in the art to augment the image capture structure of Suzuki. That reasoning does not take into account some very important distinctions between what Suzuki and Nayar disclose.

In particular, the location determination algorithm developed by Nayar is based on mathematics that relies on the fact that it utilizes reflective spheres as its optical elements. As Nayar points out (col. 3, lines 62-64), it is a physical fact that no two points on the surface of a sphere have the same surface normal vector. Importantly, Suzuki does not use spherical reflectors -- all reflectors used by Suzuki are planar. In stark contrast to a sphere, *every point* on the surface of a planar reflector has *the same* surface normal vector. Thus, in terms of specular reflection the reflector used by Nayar is *the exact opposite* of the reflector used by Suzuki.

In order to use the location determination teachings of

Nayar in the system Suzuki, it would be necessary to entirely throw out the basic operating principle of the Suzuki reflector system and start fresh. Such fundamental and sweeping changes would simply have been too much modification and experimentation to fall within what would have been merely obvious. It has been adjudicated that obviousness does not lie when the proposed modification of the prior art would involve changing the principle of operation of a reference. *See* M.P.E.P. § 2143.01 (8th ed. 2001).

The further consideration of King together with Nayar and Suzuki does nothing to rectify the flawed combination reasoning.

Accordingly, Applicant respectfully submits that the Examiner has failed to establish a *prima facie* case of obviousness with respect to claims 1-29.

D. The New Claims

Claims 33-66 are newly added by this amendment. These claims define over the prior art because, as explained in detail above, the combination of the Nayar, Suzuki, and King references does not establish a *prima facie* case of obviousness.

E. The Specification

Amendments have been made to the specification for various purposes. No new matter has been entered.

The amendments made to the text of pages 6-8 are to provide for sentence construction that is consistent with that used in the paragraph of page 7, lines 11-15.

The amendment in the paragraph at page 11, line 25 through page 13, line 12 makes the meaning of a sentence more clear.

The paragraph at page 27, line 2 through page 28, line 14 is clarified by giving an example of the type of light design useful to implement the bottom view. This is consistent with language already in the specification at page 45, line 22.

The paragraph at page 29, lines 6-20 is clarified by giving an example of the type of light design useful to implement the side view. This is consistent with language already in the specification at page 33, line 25, at page 34, line 2, and at page 43, line 25.

F. Closing

For the above reasons, Applicant respectfully submits that the application is in condition for allowance with claims 1-66. If there remain any issues that may be disposed of via a telephonic interview, the Examiner is kindly invited to contact the undersigned at the local exchange given below.

The Director of the U.S. Patent & Trademark Office is authorized to charge any necessary fees, and conversely, deposit any credit balance, to Deposit Account No. 18-1579.

Respectfully submitted,

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VERSION WITH MARKINGS TO SHOW CHANGES MADE

IN THE SPECIFICATION:

Amend the paragraphs from page 6, line 12 through page 7, line 10 as follows:

The invention further provides ~~the steps of~~ for using a part definition file that contains measurement values for an ideal part, calculating an expected position for each lead of the part for a bottom view using the measurement values from the part definition file and the X placement value and Y placement value.

The invention further provides ~~the step of~~ for using a search procedure on the image data to locate the lead.

The invention further provides ~~the step of~~ for determining a lead center location and a lead diameter in pixels and storing the lead center location and lead diameter in memory.

The invention further provides ~~the step of~~ for calculating an expected position of a center of each lead in both side perspective views in the image using a known position of each side view from calibration.

The invention further provides ~~the step of~~ for using a subpixel edge detection method to locate a reference point on each lead.

The invention further provides ~~the step of~~ for converting

the pixel values into world locations by using pixel values and parameters determined during calibration wherein the world locations represent physical locations of the lead with respect to world coordinates defined during calibration.

Amend the paragraphs from page 7, line 16 through page 8, line 11 as follows:

The invention further provides ~~the step of~~ for converting the world values to part values using the rotation, the X placement value and the Y placement value to define part coordinates for the ideal part where the part values represent physical dimensions of the lead including lead diameter, lead center location in X part and Y part coordinates and lead height in Z world coordinates.

The invention further provides ~~the step of~~ for comparing ideal values defined in the part file to calculate deviation values that represent a deviation of the center of the lead from its ideal location. The deviation values may include lead diameter in several orientations with respect to the X placement value and Y placement value, lead center in the X direction, Y direction and radial direction, lead pitch in the X direction and Y direction and missing and deformed leads, further comprising the step of calculating the Z dimension of the lead with respect to the seating plane based on the Z world data.

The invention further provides ~~the step of~~ for comparing the deviation values to predetermined tolerance values with respect to an ideal part as defined in the part definition file to provide a lead inspection result.

Amend the paragraph at page 11, line 25 through page 13, line 12 as follows:

Refer now to Figure 1A which shows the apparatus of the invention configured with a calibration reticle for use during calibration of the state values of the system. The apparatus obtains what is known as a bottom image 50 of the calibration reticle 20. To take the bottom image 50 the apparatus includes a camera 10 with a lens 11 and calibration reticle 20 with a calibration pattern 22 disposed on ~~the~~ its bottom surface. The calibration pattern 22 on the reticle 20 comprises precision dots 24. The camera 10 is located below the central part of the calibration reticle 20 to receive an image 50 described in conjunction with Figure 1B. In one embodiment the camera 10 comprises an image sensor. The image sensor may be a charged coupled device array. The camera 10 is connected to a frame grabber board 12 to receive the image 50. The frame grabber board 12 provides an image data output to a processor 13 to perform a two 15 dimensional calibration as described in

conjunction with Figure 2A. The processor 13 may store an image in memory 14. The apparatus of the invention obtains an image of a pair of side perspective views and includes using a camera 15 with a lens 16 and a calibration reticle 20. The camera 15 is located to receive an image 60, comprising a pair of side perspective views, described in conjunction with Figure 1B. Fixed optical elements 30, 32 and 38 provide a first side perspective view and fixed optical elements 34, 36, 38 for a second side perspective view. The fixed optical elements 30, 32, 34, 36 and 38 may be mirrors or prisms. As will be appreciated by those skilled in the art additional optical elements may be incorporated. The camera 15 is connected to a frame grabber board 17 to receive the image 60. The frame grabber board 17 provides an image data output to a processor 13 to perform a two dimensional inspection as described in conjunction with Figure 2B. The processor 13 may store an image in memory 14. In one embodiment of the invention, the apparatus may contain a nonlinear optical element 39 to magnify the side perspective image 60 in one dimension as shown in Figure 8A. In another embodiment of the invention optical element 38 may be a nonlinear element. The nonlinear optical elements 38 and 39 may be a curved mirror or a lens.

Amend the paragraph at page 27, line 2 through page 28, line 14 as follows:

Figure 7A shows one example of an image used in the grayscale blob method of the invention. The image processing method finds the location and dimensions of a ball 71 from a bottom image 80. From the expected position of a ball 71, a region of interest in image 80 is defined as (X1, Y1) by (X2, Y2). The width and height of the region of interest are large enough to allow for positioning tolerances of part 70 for inspection. Due to the design of the lighting for the bottom view (e.g., a ring light), the spherical shape of balls 71 of part 70 present a donut shaped image where the region 281, including the perimeter of the ball 71, comprises camera pixels of higher grayscale values and where the central region 282 comprises camera pixels of lower grayscale values. The remainder 283 of the region of interest 280 comprises camera pixels of lower grayscale values.

Amend the paragraph at page 29, lines 6-20 as follows:

Figure 7B shows one example of an image used with the method of the invention to perform a subpixel measurement of the ball reference point. The method of the invention finds a reference point on a ball 71 in an image 90 of a side perspective view as

shown in Figure 3B. From the expected position of a ball 71, a region of interest 290 in image 80 is defined as (X3, Y3) by (X4, Y4). The width and height of the region of interest are large enough to allow for positioning tolerances of part 70 for inspection. Due to the design of the lighting for a side perspective view (e.g., using a light diffuser), the spherical shape of balls 71 of part 70 present a crescent shaped image 291 comprising camera pixels of higher grayscale values and where the remainder 293 of the region of interest 290 comprises camera pixels of lower grayscale values.

IN THE CLAIMS:

Amend claim 30 as follows:

30. *(Two Times Amended)* A method for three dimensional inspection of a lead on a part, the method comprising the steps of:

using a camera ~~cameral~~ to receive an image of the lead;

transmitting the image of the lead to a frame grabber;

providing fixed optical elements to obtain a side perspective view of the lead;

transmitting the side perspective view of the lead to the frame grabber;

operating a processor to send a command to the frame grabber

to acquire images of pixel values from the camera;

processing the pixel values with the processor to calculate a three dimensional position of the lead;

determining a lead center location and a lead diameter in pixels and storing the lead center location and lead diameter in memory;

converting the pixel values into world locations by using pixel values and parameters determined during calibration wherein the world locations represent physical locations of the lead with respect to world coordinates defined during calibration, wherein a Z height of each lead is calculated in world coordinates in pixel values by combining a location of a center of a lead from a bottom view with a reference point of the same lead from a side perspective view;

converting the world coordinates to part values using a rotation, X placement value and Y placement value to define part coordinates for an ideal part where the part values represent physical dimensions of the lead including lead diameter, lead center location in X part and Y part coordinates and lead height in Z world coordinates; and

comparing ideal values defined in a part file to calculate deviation values that represent a deviation of the center of the lead from its ideal location.